Available online at www.sciencedirect.com
ScienceDirect
Theoretical Computer Science 382 (2007) 1–2
Theoretical Computer Science
www.elsevier.com/locate/tcs

Preface: Quantitative aspects of programming languages

Quantitative aspects are increasingly pervading research in Computer Science covering areas where the qualitative viewpoint has prevailed for a long time. In fact, the introduction of elements such as time and probability in high-level specification and programming languages is a popular practice in today's research; equally popular are the extension of classical static analysis and model checking techniques with probabilistic/time features, and the integration of performance aspects in formal methods.

The idea of a dedicated forum for researchers working with quantitative aspects in different fields of Computer Science was brought into concrete existence in 2001 with the First Workshop on *Quantitative Aspects of Programming Languages (QAPL'01)*. This workshop was organised by Alessandra Di Pierro and Herbert Wiklicky as a satellite event of *Principle, Logic, and Implementation of high-level programming languages (PLI'01)* in Florence. The idea was well received and a second edition (*QAPL'04*) was organised in Barcelona as a satellite workshop of the *European joint conferences on Theory And Practice of Software (ETAPS'04)*. The QAPL workshops are since then yearly meetings where a growing number of researchers working on various topics related to quantitative aspects in Computer Science present and discuss their results, while a number of invited keynote speakers report on the state-of-the-art of research in the various areas covered by the workshop. The successive *QAPL'05* and *QAPL'06* workshops were held in Edinburgh and Vienna, respectively, again as satellites of the ETAPS conferences.

This issue of *Theoretical Computer Science* collects four papers selected from among fifteen submissions received as a result of a general call for papers in conjunction with the *QAPL'06* workshop. Among these submissions one was an extended version of a paper presented at *QAPL'06*. The remaining three are additional contributions received after the workshop. All papers have been peer-reviewed according to the TCS standards. A number of referees helped in this effort, to whom goes our warmest gratefulness for the excellent job they did by scrupulously reading the submissions and carefully writing their detailed reports; it allowed us to rely on an exceptionally high quality two-phase review process for the selection of the best papers. We also wish to thank the authors who undertook the effort to incorporate the various comments and improvements required by the reviewing process.

The four contributions in this issue address one of the main focuses of the workshop, namely the use of formal methods for the analysis and verification of non-functional (quantitative) properties of systems.

The paper by Alessandro Aldini and Marco Bernardo on "Mixing Logics and Rewards for the Component-Oriented Specification of Performance Measures" concentrates on the problem of specifying performance measures in the context of various system models for performance evaluation. To this purpose the authors propose a mixed approach where classical reward-based methods are combined with logical constructs so as to allow for a component-oriented specification of performance measures. The resulting specification language can be interpreted both at the level of stochastic process algebras and in terms of their semantic realisation as action-labelled continuous-time Markov chains.

Continuous-Time Markov Chains (CTMC) are the reference model for the stochastic behaviour of systems in performance evaluation. Quantitative properties for this model can be expressed using the branching-time temporal logic CSL. In "CSL Model Checking Algorithms for QBDs" Anne Remke, Boudewijn Haverkort and Lucia Cloth tackle the problem of model checking such properties on infinite-state CTMC. This is a highly complex problem that cannot be easily avoided since for many applications finite-state models would not allow for an appropriate specification. In their contribution Remke et al. suggest as a solution that we restrict the infinite-state CTMC to

0304-3975/$ - see front matter
doi:10.1016/j.tcs.2007.05.005

the particular class of quasi-birth death (QBD) models, and present a complete description of the model checking algorithms for this class.

The third contribution, “Model Checking Mobile Stochastic Logic” by Rocco De Nicola, Joost-Pieter Katoen, Diego Latella, Michele Loreti and Mieke Massink, is concerned with the issue of mobility and global computing. It reports on a logic extending CSL in order to deal with resource and mobility aspects of concurrent behaviours and show how formulae in this logic can be model checked against models specified in STOCKLAIM. This is a stochastic distributed language previously developed for modelling code and agent interaction and mobility.

The use of random variables is pervasive in all those fields where randomness and uncertainty are unavoidable elements, e.g. the verification of physical systems and computer-based probabilistic analysis techniques such as simulation. This has motivated the work by Osman Hasan and Sofiène Tahar on finding a formalisation of these important mathematical objects. In their contribution “Formalization of the Standard Uniform Random Variable”, Hasan et al. show how to specify the standard uniform random variable (corresponding to the uniform distribution over the unit interval [0, 1]) within the HOL theorem prover for the purpose of providing a mechanised tool for evaluating probabilistic quantities. They demonstrate their verification methodology by presenting a simple probabilistic analysis of round-off error in HOL.

Alessandra Di Pierro*
Dipartimento di Informatica,
University of Verona,
Verona,
Italy
E-mail address: dipierro@sci.univr.it.
URL: http://profs.sci.univr.it/~dipierro.

Herbert Wiklicky
Department of Computing,
Imperial College London,
London,
UK
E-mail address: herbert@doc.ic.ac.uk.
URL: http://www.doc.ic.ac.uk/~herbert.

* Corresponding editor.